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Water Resources of Birch Creek National Wild River, Alaska

Stream Gaging Data from 1989 to 1994

Jon Kostohrys and Bunny B.G. Sterin

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Introduction

The Alaska National Interest Lands Conservation Act of December 2, 1980 (ANILCA, P.L. 96-487) established the upper portion of Birch Creek as a component of the National Wild and Scenic Rivers System. Approximately 126 miles of Birch Creek were classified "wild" pursuant to the Wild and Scenic Rivers Act (USDI 1983). However, National Wild River status does not necessarily protect river flows, and the language contained in the Wild and Scenic Rivers Act does not guarantee a specific flow regime. The river management plan for Birch Creek Wild River (USDI 1983) specifies that "a reservation of minimum water flows sufficient for public recreation use and to support the values for which the river was designated will be determined in cooperation with the Alaska Department of Natural Resources (DNR)." This directive provided the impetus for a water rights assessment of the Birch Creek National Wild River.

The Bureau of Land Management (BLM) initiated a water resources inventory for the purposes of preparing a water rights assessment document in 1990. The intent was to apply for a state water right for instream flow following the processing and evaluation of the data.

In the past, the State of Alaska Department of Natural Resources, Division of Mining and Water Management has required the BLM to document stream flow during a 10-year period after a water right has been granted. BLM has been collecting streamflow data on Birch Creek since 1989 in support of a water rights reservation.

This report presents a summary of streamflow data collected on the river from 1989 to 1994 by the BLM and the State of Alaska Division of Mining and Water Management. The BLM will continue to inventory the water resources on Birch Creek in support of its eventual water rights application and to provide managers and resource users with the information necessary for management and utilization of this watershed.

Description of the Study Area

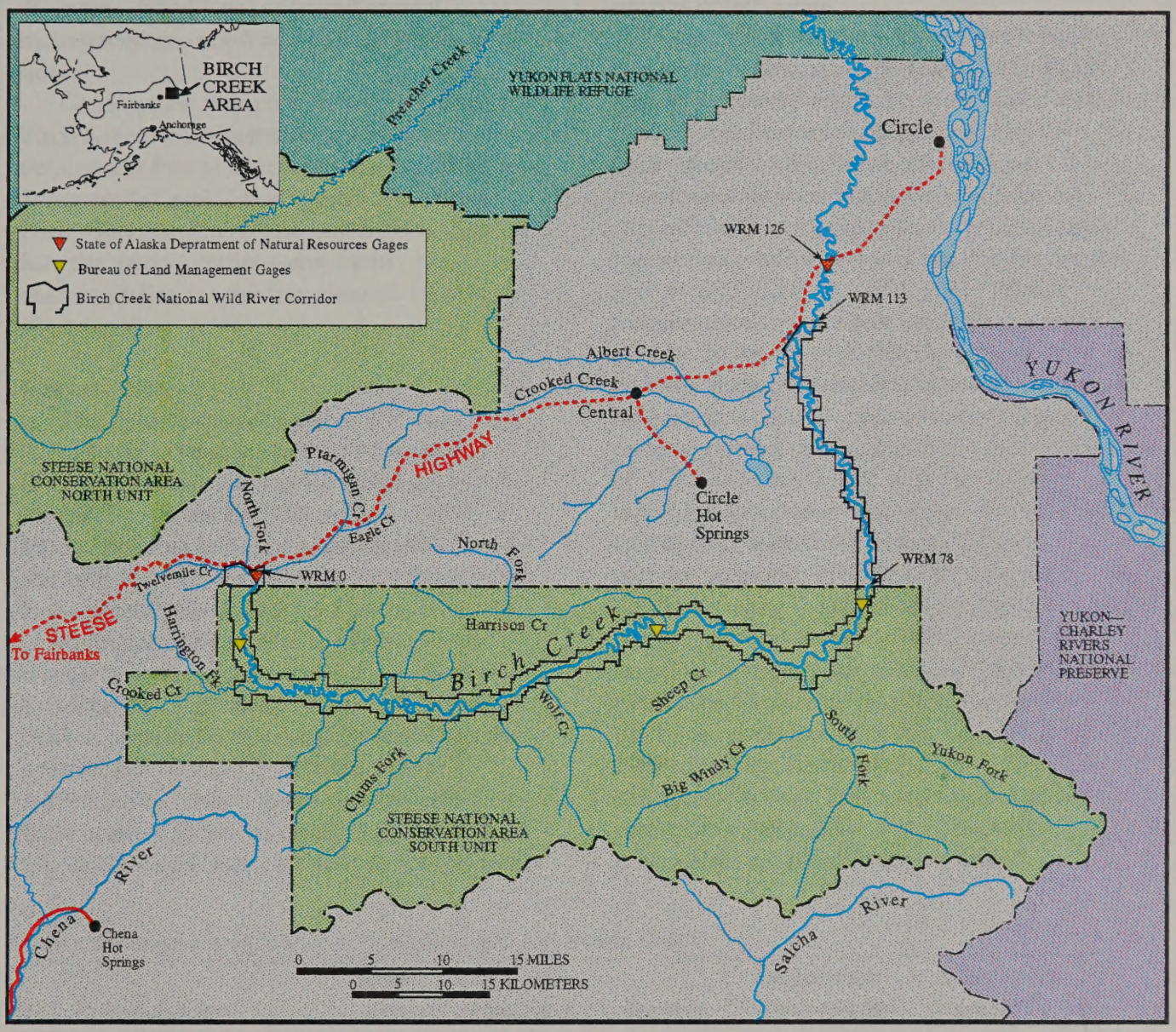
This report addresses the 126 miles of Birch Creek included in the National Wild and Scenic Rivers System (see Figure 1), beginning approximately one mile upstream of the confluence with Twelvemile Creek, Wild River Mile (WRM) 0, and ending at the Steese Highway Bridge (WRM 126).

The Birch Creek watershed, located in the eastern interior of Alaska, is part of the Yukon-Tanana physiographic province. This area is characterized by forested upland plateaus, some of gentle relief but others topped by steep 4,000 to 5,000 foot tundra-covered mountains. Intervening valleys, narrow in the headwaters, widen down valley into extensive marshy lowlands, underlain by discontinuous permafrost. Ultimately, the region is drained by the Yukon River. A succinct summary of the basin is given by Ellsworth and Davenport in their original description of the watershed (USDI 1915):

> *Birch Creek is formed by the junction of Eagle and Ptarmigan creeks and flows southwestward for about 7 miles to the mouth of Twelvemile Creek, where it turns abruptly to the south and follows that direction for about 8 miles. It then receives the waters of Harrington Fork and takes an easterly course for about 45 miles to its confluence with the South Fork. The river then makes a sharp turn north and about 12 miles farther on leaves the mountainous country and enters the lowlands of the Yukon, through which it meanders sluggishly for over 100 miles, roughly paralleling the Yukon. Birch Creek flows into the Yukon River . . . about 25 miles directly west of Fort Yukon.*

The basin lies in the subpolar continental climatic zone that features long cold winters and short hot summers. Temperature extremes range from -70 degrees Fahrenheit (F) in winter to +90 degrees F in summer. Precipitation averages 10 to 15 inches per year at nearby recording stations, though variations are great due to surrounding topography. Precipitation is generally greater at higher elevations and during the summer, with most coming as rainfall from late June to early September (U.S.D.C. 1963). Snowfall averages roughly 50 inches per year with about 20 inches remaining on the ground prior to spring break-up, which usually begins in late April to mid-May. Freeze-up often begins at higher elevations in mid-September, though some streams lower in the basin remain open until November. Ice cover is usually continuous over the winter, except in the vicinity of springs, and freezing to the bottom may occur (Webb 1982-86).

Birch Creek National Wild River



Methods

The hydrologic analysis of Birch Creek was developed using traditional hydrologic analyses of stream gage data (Rantz, et al. 1982). The goal of the hydrologic assessment was to determine annual monthly mean discharge, flood frequency and annual instantaneous peak flows and minimum daily flows.

Gaging data was collected at five sites on Birch Creek. Supplementary data was also obtained at five of the river's main tributaries: Twelvemile Creek, Harrington Fork, Clums Fork, Harrison Creek and South Fork. Table 1 lists the gaging stations and basin characteristics for the five stations located on Birch Creek.

Gaging Data

The United States Geological Survey (USGS) did extensive stream gaging in the Birch Creek basin during the initial gold rush, a period from about 1908 to 1912 (USDI 1915). Prior to 1990, the only recent streamflow data are published by the Alaska Department of National Resources, Division of Mining and Water Management. These consist of stream gages on Birch Creek above Twelvemile Creek and at the Steese Highway Bridge, seasonally operated from 1985 to the present (Ray 1990-92; Vohden 1994). Additionally, stream gages were installed by BLM at three locations on Birch Creek in the fall of 1989 and data collected to the present. All estimates of winter discharge were based on BLM streamflow measurements at these sites. All flow measurements, cross-sectional surveys, and daily discharge data from the DNR gages from 1989 to 1994 are in the reports noted above.

At each field site, gages were surveyed to reference elevation (bench) marks, significant high-water marks and the current water level following Dalrymple and Benson, 1967. Cross-sectional discharge (streamflow) measurements were made using a Price AA current meter to measure water velocity and a top-setting wading rod and tag line for depth and width following USDI, 1967. Winter measurements were made by drilling a series of holes in the ice to define the cross-section and measuring the depth and velocity in each hole using a vertical-axis, vane-type current meter mounted on a graduated rod (Rantz et al. 1982). At sites where and automated water-level recorder (data-logger and pressure transducer) were installed, multiple cross sections were surveyed to determine peak discharge using the slope-area method (Dalrymple and Benson 1967). Rating curves and (log-log regression plots) of water level versus discharge were then developed from discharge measurements made from 1989 to 1994 following Rantz et al., 1982. These rating curves were then used to compute the rating tables and daily means, monthly means, and annual discharge values.

Table 1
Gage locations and basin characteristics for Birch Creek

Gage Site	River Mile	Drainage Area (mi^2)	Gradient	Mean Basin Elevation (ft)	Lake/Pond area (mi^2)
Above Twelvemile Creek	0	85	0.006	3,110	0
Below Twelvemile Creek	6	156	0.005	3,030	0
Above Harrison Creek	54	763	0.004	2,570	0
Below South Fork	77	1,350	0.005	2,620	0
Steese Highway Bridge	126	2,150	0.002	2,240	8

Hydrologic Regime

The monthly mean flow hydrographs for Birch Creek stations were derived from DNR gaged data (Ray 1990-92; Vohden 1995), BLM winter discharge measurements, data logger, and crest stage gage data. Computation of monthly mean discharge at the sites with crest stage gages were determined by regression analysis of data logger records from the gage below South Fork, selected as the reference gage. Periods of no data, generally during April and May when water levels fluctuate due to the effects of ice and snow run-off were estimated from regression comparisons with the Salcha River (USGS 1990-1995; Riggs 1967).

Streamflow for the winter period was estimated using log-linear regression curves derived from under ice discharge measurements. One set of measurements was made in late fall/early winter and another in late winter/early spring to define the fall recession and winter low flow, respectively. This methodology assumes that once ice and snow cover isolate the stream from precipitation and temperature changes, the flow to the stream recedes uniformly as the water table in the aquifer is lowered by a reduction of the water volume in the aquifer (Rogers and Armbruster 1990). Accuracy of winter flows is low; as discharge approaches zero, flow measurements become unreliable as the water velocity diminishes below the measuring range of the flow meter. Variability in the basin can occur as flows diminish downstream from the headwaters due to storage as ice. Streamflow may cease altogether if additional groundwater sources are not available. A flow measurement at one site may have little relationship to other sites in the basin unless geological conditions remain constant. Flow in the lower, unconfined alluvial channels is greater and shows more uniformity than in the upper portions of a basin where bedrock confines the aquifer and groundwater sources are non-continuous (Nelson 1978). Because of these factors, discharges less than about 10 cubic feet per second should be considered estimates. Log-linear regressions were done for all sites to estimate the winter period, generally October through March.

Peak flow statistics were computed from the annual instantaneous peak data using a log-Pearson Type III distribution (Benson 1968). Since these values are based on a limited data set, they were evaluated using the peak flow statistics computed from regional regression equations (Parks and Madison 1985; Jones and Fahl 1994).

Results

A monthly mean discharge data summary for the period of record was computed for the five gaged Birch Creek sites (Table 2 and Figure 2). Table 3 presents a summary of hydrologic statistics through the period of record. The flood-frequency statistics computed from the Birch Creek instantaneous peak data (Table 4) are listed in Table 5. Instantaneous flood-frequencies, computed from regional estimators, are listed in Tables 6 and 7. Generally, the gaged values appear reasonable for the high frequency, lower magnitude floods, but they differ markedly at the higher magnitude, low frequency events. To compare the regional estimators to a long term data set, the USGS data for the Salcha River, a gage run since 1949 and used to estimate some of the Birch Creek Data, was chosen. The Salcha River data (Table 8) compares well with the flood-frequency estimators at lower discharge, but differs at the higher magnitude floods, similar to Birch Creek. To fully evaluate the accuracy of the Birch Creek hydrologic statistics, the gaging program should continue until all sites have at least 10 years of record (USDI 1982).

Appendix A contains discharge data listed by year and site location for the period of record. A summary table at the end of each year's data lists the monthly mean streamflow. This was computed from the recorded daily values table, regression equations based on winter under-ice measurements, and comparisons to other sites on Birch Creek or the Salcha River. Appendix B lists the discharge ratings and regression parameter values used in the computations.

Table 2
Monthly mean discharge of Birch Creek, 1989 to 1994

	Discharge (cfs) Birch Creek				
Month	Above Twelvemile Ck	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	Steese Hwy Bridge
January	2.4	8.6	15	29	60
February	1.6	7.1	8.5	16	41
March	1.2	5.3	5.8	10	29
April	18	48	152	258	345
May	193	385	1,483	2,431	3,795
June	**177**	256	948	1,565	**2,522**
July	**58**	138	484	807	**1,244**
August	**59**	159	565	940	**1,384**
September	**61**	165	591	982	**1,434**
October	31	65	302	406	737
November	13	29	109	161	267
December	5	15	41	66	109

999 Alaska DNR data (Ray 1990, 1991, and 1992, Vohden 1994 and 1995)

Figure 2
Monthly mean discharge of Birch Creek, 1989 to 1994

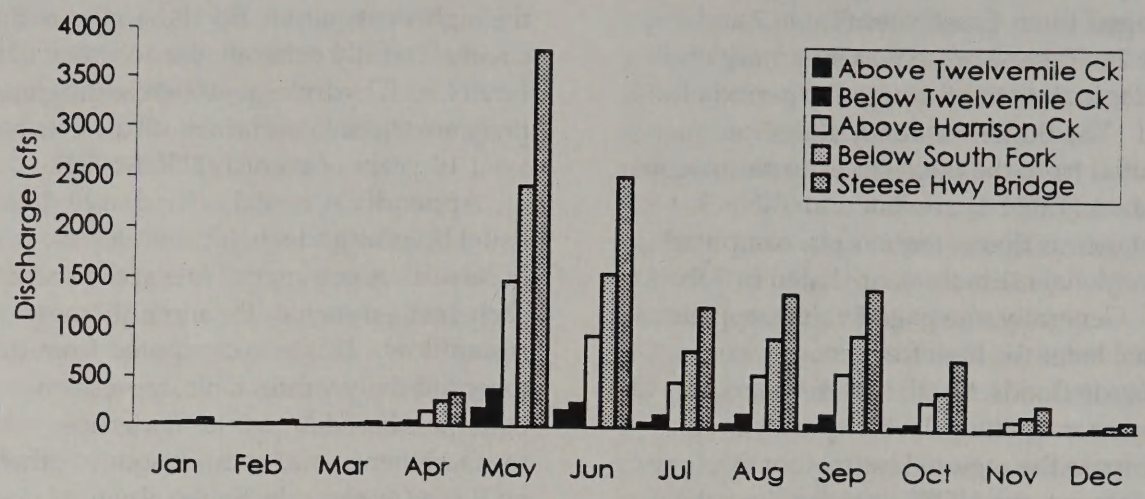


Table 3
Summary of hydrologic statistics for Birch Creek, 1989 to 1994

Statistic	Birch Creek Above Twelvemile Creek	Below Twelvemile Creek	Above Harrison Creek	Below South Fork	Steese Highway Bridge
Mean Annual Discharge (cfs)	52	107	392	639	997
Annual Runoff (cfsm)	0.61	0.68	0.51	0.47	0.46
Annual Runoff (inches)	8.3	9.3	7.0	6.4	6.3
Instantaneous Peak Discharge (cfs)	2,000	3,570	15,340	28,750	43,400
Instantaneous Minimum Discharge (cfs)	0.34	3.0	0.50	1.0	11
Highest Mean Daily Discharge (Recorded) (cfs)	1,070	ND	ND	17,075	19,300
Lowest Mean Daily Discharge (Recorded) (cfs)	13	ND	ND	220	385

ND: Not determined.

Table 4
Instantaneous peak discharge summary for Birch Creek, 1989 to 1994

Year	Discharge (cfs) Birch Creek Above Twelvemile Ck	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	Steese Hwy Bridge
1989	1,940	3,570	11,000	28,750	43,400
1990	988	2,113	4,285	5,996	7,530
1991	823	1,346	6,557	8,366	16,300
1992	498	1,583	5,025	7,716	4,810
1993	ND	1,665	6,271	9,286	ND
1994	2,000	2,882	15,340	19,987	29,000

ND: Not determined

Table 5
Log Pearson III instantaneous flood-frequency summary for Birch Creek

Recurrence Interval (yrs)	Discharge (cfs) Birch Creek Above Twelvemile Ck *	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	Steese Hwy Bridge **
2	885	1,995	6,870	9,760	11,800
5	1,500	2,800	10,700	18,100	23,600
10	1,820	3,400	13,900	26,200	37,100
25	2,110	4,260	19,000	40,100	56,400
50	2,270	4,960	23,600	53,800	94,000
100	2,390	5,730	29,000	71,200	138,000

* Includes historical data from before 1989.
**Includes historical data from before 1989 and an estimate of the 1967 flood.

Table 6
Instantaneous flood-frequencies estimated for Birch Creek from Parks and Madison (1985)

Recurrence Interval (yrs)	Discharge (cfs) Birch Creek Above Twelvemile Ck	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	Steese Hwy Bridge
2	764	1,327	5,625	9,455	14,440
5	1,367	2,291	8,831	14,344	21,303
10	1,883	3,098	11,388	18,182	26,629
25	2,764	4,439	15,311	23,895	34,351
50	3,622	5,746	19,199	29,622	42,190
100	4,570	7,120	22,684	34,405	48,324

Table 7
Instantaneous flood-frequencies estimated for Birch Creek from Jones & Fahl (1994)

	Discharge (cfs) Birch Creek				
Recurrence Interval (yrs)	Above Twelvemile Ck	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	Steese Hwy Bridge
2	921	1,599	6,992	11,570	18,490
5	1,525	2,566	10,279	16,533	25,643
10	1,937	3,207	12,316	19,535	29,870
25	2,479	4,041	14,875	23,267	35,078
50	2,845	4,595	16,495	25,585	38,258
100	3,219	5,158	18,117	27,896	41,418

Table 8
Instantaneous flood-frequencies for the Salcha River for comparative purposes (from USGS data)

	Discharge (cfs)		
Recurrence Interval (yrs)	Log Pearson III (USGS data)	Parks & Madison Estimator	Jones & Fahl Estimator
2	16,700	14,562	17,976
5	26,500	21,472	25,027
10	34,000	26,832	29,198
25	44,600	34,600	34,340
50	53,300	42,488	37,479
100	62,600	48,652	40,599

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Appendix A: Yearly Statistics

Table A-1
Discharge measurement summary at gaged sites for Birch Creek, 1989

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Above Twelvemile Creek						
September 26	24	ND	35	36	0.64	1.0
December 12	3.9	ND	14	9	0.41	0.8
Below Twelvemile Creek						
June 25	*3,570	7.58	124	655	5.45	5.3
September 5	36	1.60	56	35	0.81	0.7
December 5	12	ND	53	31	0.28	0.6
Above Harrison Creek						
June 25	*11,000	12.00	207	1,810	6.08	8.7
October 5	173	0.61	101	100	1.65	1.0
November 30	46	ND	110	59	0.49	0.6
Below South Fork						
June 25	*28,750	12.54	277	3,420	8.41	12.3
October 5	255	1.09	75	119	2.20	0.9
November 30	90	ND	45	73	1.14	1.6
Steese Highway Bridge						
June 26	*43,400	14.57	3,448	11,270	3.85	3.3
June 28	8,815	7.01	286	1,917	4.43	7.2
September 26	393	1.45	255	219	1.90	0.9
December 8	89	ND	195	260	0.31	1.4

* Slope-area indirect discharge
ND: Not determined

Table A-2
Annual instantaneous peak discharge of Birch Creek, 1989

Station	Discharge (cfs)
Above Twelvemile Creek	1,940
Below Twelvemile Creek	3,570
Above Harrison Creek	11,000
Below South Fork	28,750
At Steese Highway Bridge	43,400

Table A-3
Monthly mean discharge of Birch Creek, 1989

	Discharge (cfs) Birch Creek				
	Above Twelvemile Ck.	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	At Steese Highway Bridge
January	ND	ND	ND	ND	ND
February	ND	ND	ND	ND	ND
March	ND	ND	ND	ND	ND
April	ND	ND	ND	ND	ND
May	ND	ND	ND	ND	ND
June	**164**	ND	ND	ND	**2,170**
July	**90**	ND	ND	ND	**1,770**
August	**37**	ND	ND	ND	**675**
September	**27**	ND	ND	ND	**507**
October	*15*	*22*	*135*	*210*	*264*
November	*7*	*15*	*64*	*118*	*141*
December	*3*	*11*	*32*	*68*	*77*

999 Alaska DNR data (Ray, 1990)
999 Estimated from regression equations
ND: Not determined

Table A-4
Daily mean discharge of Birch Creek below South Fork, 1990

	Discharge (cfs)				
Date	May	June	July	August	September
1		1,219	661	375	1,219
2		1,179	413	505	2,044
3		1,166	343	1,028	
4		1,170	310	906	
5		2,070	279	783	
6		3,188	260	709	
7		2,445	310	666	
8		2,004	517	634	
9		1,425	573	591	
10		2,617	785	542	
11		1,625	963	556	
12		1,255	780	541	
13		1,171	670	526	
14		1,189	654	534	
15	5,731	1,035	609	556	
16	5,075	1,096	585	606	
17	4,683	1,027	538	702	
18	5,022	875	442	814	
19	4,995	814	383	879	
20	4,348	739	350	855	
21	3,253	699	318	917	
22	2,773	638	288	1,008	
23	1,875	611	280	1,054	
24	1,372	520	278	1,019	
25	1,252	464	329	993	
26	1,230	408	338	966	
27	1,250	359	322	929	
28	1,218	376	319	934	
29	1,178	941	312	1,239	
30	1,168	980	325	1,277	
31	1,142		354	1,199	
Maximum	5,731	3,188	963	1,054	2,044
Minimum	1,142	359	260	375	1,219
Mean	2,798	1,177	483	721	1,631

Recorded instantaneous peak: 5.37 feet or 5,996 cfs on May 15
Recorded minimum discharge: 250 cfs on July 6
Gage operated: May 15 to September 20
Transducer plugged: September 3-20

Table A-5
Discharge measurement summary at gaged sites for Birch Creek, 1990

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Above Twelvemile Creek						
March 29	0.3	ND	8.0	3.9	0.11	0.6
December 7	8.7	ND	23	13	0.73	0.6
Below Twelvemile Creek						
June 12	134	2.76	57	83	1.45	1.7
July 21	54	1.29	106	33	1.28	0.7
September 20	179	3.14	62	79	2.00	1.4
December 14	16	ND	24	17	0.95	0.8
Above Harrison Creek						
June 14	874	2.18	112	247	3.46	2.4
September 20	720	1.95	133	319	2.57	2.3
December 12	53	ND	45	25	2.25	0.6
Below South Fork						
March 21	1.9	ND	20	20	0.11	1.1
June 15	1,094	2.09	350	345	2.79	0.2
July 24	279	1.13	241	141	1.80	0.6
September 20	1,255	2.18	282	398	2.96	1.5
December 12	101	ND	46	93	1.24	2.7
Steese Highway Bridge						
April 6	15	ND	155	94	0.17	2.1
December 7	123	ND	235	97	0.83	0.5

ND: Not determined

Table A-6
Discharge measurement summary at ungaged sites for Birch Creek, 1990

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Below Malburn Creek						
July 21	93	3.10	45	87	1.08	2.2
Above Clums Fork						
July 22	78	1.65	57	75	0.88	1.5
Below Crooked Creek						
July 26	345	4.80	140	154	1.93	1.1
November 1	393	ND	275	165	1.15	1.0
Twelvemile Creek at Birch Ck						
July 12	44	3.21	48	25	1.68	0.6
August 2	34	3.19	28	33	0.92	1.3
August 27	89	3.16	35	43	1.80	1.4
Harrington Fork at Birch Creek						
June 12	77	1.15	50	33	2.18	0.7
September 20	106	1.30	50	39	2.60	0.8
Clums Fork at Birch Creek						
June 13	379	1.76	108	123	3.06	1.4
July 22	54	1.25	62	45	1.19	0.8
South Fork at Birch Creek						
July 24	87	2.10	89	63	1.11	0.7

ND: Not determined

Table A-7
Annual instantaneous peak discharge of Birch Creek, 1990

Station	Discharge (cfs)
Above Twelvemile Creek	**988**
Below Twelvemile Creek	2,113
Above Harrison Creek	4,285
Below South Fork	5,996
At Steese Highway Bridge	**7,530**

999 Alaska DNR data (Ray 1991)

Table A-8
Monthly mean discharge of Birch Creek, 1990

	Discharge (cfs) Birch Creek				
Month	Above Twelvemile Ck.	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	At Steese Highway Bridge
January	*1.7*	*3.4*	*3.5*	*18*	*51*
February	*0.9*	*1.4*	*0.7*	*6.5*	*32*
March	*0.5*	*0.6*	*0.1*	*2.4*	*21*
April	*20*	*51*	*161*	*275*	*366*
May	*189*	*440*	*1,710*	2,798	*4,068*
June	**99**	*197*	*709*	1,177	**2,100**
July	**36**	*86*	*286*	483	**748**
August	**50**	*125*	*431*	721	**1,680**
September	**116**	*266*	*988*	1,631	**2,840**
October	*34*	*87*	*323*	*579*	*878*
November	*15*	*36*	*122*	*226*	*275*
December	*6.9*	*16*	*48*	*91*	*119*

999 Alaska DNR data (Ray 1991)
999 Estimated from regression equations

Table A-9
Daily mean discharge of Birch Creek below South Fork, 1991

	Discharge (cfs)				
Date	May	June	July	August	September
1		5,279	431	923	1,091
2		4,318	399	815	1,005
3		2,710	410	913	933
4		2,107	483	1,214	896
5		1,705	504	1,266	882
6		2,047	476	1,302	845
7		2,514	402	1,461	806
8		1,993	367	1,418	784
9		1,471	321	1,268	794
10		1,307	304	1,113	798
11		1,269	299	952	929
12		1,730	299	842	1,553
13		2,039	305	788	1,620
14		1,582	287	749	1,401
15		1,318	281	707	1,351
16		1,232	279	669	1,306
17		1,113	285	1,496	1,170
18		994	272	4,450	1,063
19		955	265	5,580	978
20		898	246	3,039	
21		846	233	2,134	
22		784	225	1,731	
23	2,859	737	220	2,355	
24	2,581	832	584	3,597	
25	2,483	724	1,335	2,788	
26	2,556	682	1,486	2,051	
27	2,997	795	1,228	1,686	
28	2,323	667	1,208	1,461	
29	2,067	605	1,181	1,324	
30	1,950	497	1,021	1,276	
31	1,640		963	1,182	
Maximum	2,997	5,279	1,486	5,580	1,620
Minimum	1,640	497	220	669	784
Mean	2,384	1,525	535	1,695	1,063

Recorded instantaneous peak: 6.43 feet or 8,355 cfs on August 20
Recorded minimum discharge: 215 cfs on July 25
Gage operated: May 23 to September 19

Table A-10
Discharge measurement summary of gaged sites for Birch Creek, 1991

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Above Twelvemile Creek						
March 21	3.1	ND	6	2	1.52	0.4
December 27	2.7	ND	8	2	1.75	0.3
Below Twelvemile Creek						
March 21	11	ND	21	20	0.79	0.9
May 23	551	4.12	99	169	3.30	1.9
September 19	152	3.02	59	53	2.70	1.0
December 27	7.8	ND	20	6	1.63	0.4
Above Harrison Creek						
March 8	26	ND	40	33	0.86	0.9
September 19	680	1.77	115	259	2.52	2.4
December 18	30	ND	51	36	0.82	0.8
Below South Fork						
March 8	38	ND	46	61	0.62	1.4
August 15	822	1.74	305	337	2.13	1.1
December 18	35	ND	105	150	0.33	1.5
Steese Highway Bridge						
April 18	71	ND	160	285	0.33	1.9
December 23	80	ND	60	46	1.85	0.8

ND: Not determined

Table A-11
Discharge data summary at ungaged sites for Birch Creek, 1991

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Below Crooked Creek						
March 8	31	ND	80	40	0.87	0.6
Harrison Creek at Birch Creek						
September 19	85	1.30	41	36	2.26	0.9

ND: Not determined

Table A-12
Annual instantaneous peak discharge of Birch Creek, 1991

Station	Discharge (cfs)
Above Twelvemile Creek	**823**
Below Twelvemile Creek	1,346
Above Harrison Creek	6,557
Below South Fork	8,366
At Steese Highway Bridge	**16,300**

999 Alaska DNR data (Ray 1992)

Table A-13
Monthly mean discharge of Birch Creek, 1991

	Discharge (cfs) Birch Creek				
	Above Twelvemile Ck.	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	At Steese Highway Bridge
January	*5.8*	*11*	*40*	*69*	*105*
February	*4.3*	*14*	*31*	*49*	*93*
March	*3.3*	*13*	*25*	*35*	*82*
April	*13*	*33*	*102*	*174*	*229*
May	**311**	*393*	*1,511*	2,477	**4,030**
June	**144**	*250*	*922*	1,525	**2,700**
July	**53**	*95*	*318*	535	**1,050**
August	**167**	*276*	*1,027*	1,695	**3,070**
September	**77**	*179*	*639*	1,063	**1,540**
October	*34*	*69*	*271*	*367*	*786*
November	*12*	*28*	*94*	*119*	*283*
December	*4.1*	*11*	*33*	*38*	*102*

999 Alaska DNR data (Ray 1992)
999 Estimated from regression equations
ND Not determined

Table A-14
Daily mean discharge of Birch Creek below South Fork, 1992

	Discharge (cfs)			
	June	July	August	September
1			2,409	741
2			2,321	746
3			2,208	746
4			1,999	726
5			1,770	707
6			1,472	687
7			1,241	663
8	2,008		1,089	638
9	1,638		965	653
10	1,630		808	636
11	1,652		739	616
12	1,504		723	601
13	1,436		708	601
14	1,258		819	577
15	1,660		750	540
16	2,008		749	
17	2,884		694	
18	2,428		747	
19	1,667		722	
20	1,289		729	
21	1,256		746	
22	1,664		761	
23	2,450	474	737	
24	1,704	654	718	
25	1,446	782	878	
26	1,437	1,231	841	
27	1,324	2,410	824	
28		2,591	831	
29		2,508	894	
30		2,540	819	
31		2,665	813	
Maximum	2884	2665	2409	746
Minimum	1256	474	694	540
Mean	1717	1762	1049	659

Recorded instantaneous peak: 3.55 feet or 3,065 cfs on June 17
Surveyed instantaneous peak: 6.01 feet or 7,716 cfs on June 1 (from flood marks)
Recorded minimum discharge: 425 cfs on July 23
Gage operated: June 8 to September 25
Transducer plugged: June 28-July 22
Backwater from ice: September 16-25

Table A-15
Discharge measurement summary at gaged sites for Birch Creek, 1992

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Above Twelvemile Creek						
March 25	2.1	ND	11	35	0.07	0.9
Below Twelvemile Creek						
March 25	3.0	ND	7	7	0.40	1.2
June 8	326	3.75	88	103	2.68	1.4
August 12	50	2.86	63	40	1.08	0.6
September 25	31	2.87	47	25	1.15	0.6
November 20	13	ND	44	22	0.57	0.4
Above Harrison Creek						
March 9	3.0	ND	10	3	1.10	0.4
July 23	222	0.62	85	108	1.90	1.3
Below South Fork						
March 9	8.2	ND	40	44	0.20	1.4
June 8	2,270	2.83	208	1,128	1.90	5.9
July 23	453	1.21	99	165	2.58	1.9
September 25	168	0.91	60	105	1.54	1.9
November 12	75	ND	36	62	1.20	1.9
Steese Highway Bridge						
March 9	21	ND	75	70	0.36	0.9

ND: Not determined

Table A-16
Annual instantaneous peak discharge of Birch Creek, 1992

Station	Discharge (cfs)
Above Twelvemile Creek	**498**
Below Twelvemile Creek	1,583
Above Harrison Creek	5,025
Below South Fork	7,716
At Steese Highway Bridge	**4,810**

999 Alaska DNR data (Vohden 1994)

Table A-17
Monthly mean discharge of Birch Creek, 1992

	Discharge (cfs) Birch Creek				
	Above Twelvemile Ck.	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	At Steese Highway Bridge
January	*2.6*	*6.3*	*13*	*24*	*52*
February	*2.4*	*4.6*	*5.8*	*13*	*31*
March	*2.2*	*3.3*	*2.5*	*7.2*	*19*
April	*6*	*17*	*49*	*86*	*110*
May	*183*	*427*	*1,656*	*2,710*	*3,936*
June	**178**	*280*	*1,041*	1,717	**2,430**
July	**56**	*164*	*582*	*970*	**1,210**
August	**34**	*177*	*630*	1,049	**1,300**
September	**30**	*115*	*393*	659	**801**
October	*8.7*	*23*	*69*	*119*	*222*
November	*5.2*	*14*	*41*	*71*	*87*
December	*1.9*	*12*	*14*	*25*	*56*

999 Alaska DNR data (Vohden 1994)
999 Estimated from Regression Equations

Table A-18
Daily mean discharge of Birch Creek below South Fork, 1993

	Discharge (cfs)				
Date	May	June	July	August	September
1		1,171	990	300	1,105
2		1,046	1,101	286	1,739
3		1,016	1,379	283	1,718
4		956	1,055	288	1,456
5		919	835	302	1,306
6		916	696	339	1,193
7		1,031	675	613	1,077
8		925	643	955	992
9		1,012	590	764	950
10		1,353	533	653	914
11		1,424	472	603	896
12		1,134	445	555	905
13		1,020	434	513	954
14		822	397	495	1,126
15		695	372	495	1,170
16		636	370	478	1,085
17		696	370	470	1,048
18		743	393	454	1,114
19		829	391	444	1,024
20		2,336	370	427	1,364
21		2,167	356	414	1,920
22		1,325	340	452	2,187
23		928	324	933	
24		860	342	1,328	
25	2,246	835	358	1,188	
26	2,276	851	367	997	
27	2,304	883	346	882	
28	1,849	796	332	781	
29	1,783	728	311	683	
30	1,717	708	317	667	
31	1,428		305	732	
Maximum	2,304	2,336	1,379	1,328	1,739
Minimum	1,428	636	305	283	896
Mean	1,943	1,025	523	606	1,146

Recorded instantaneous peak: 3.36 feet or 2,831 cfs on June 20
Surveyed instantaneous peak: 6.63 feet or 9,286 cfs on May 20 (from flood marks)
Recorded minimum discharge: 290 cfs on August 3.
Gage operated: May 25 to September 22

Table A-19
Discharge measurement summary at gaged sites for Birch Creek, 1993

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Above Twelvemile Creek						
December 2	6.0	ND	75	70	0.36	0.9
Below Twelvemile Creek						
March 15	8.0	ND	52	18	0.43	0.5
May 25	549	4.32	116	168	2.70	1.5
September 22	312	3.92	92	135	2.13	1.6
December 2	25	ND	46	22	1.16	0.5
Above Harrison Creek						
March 22	0.5	ND	10	3	1.10	0.4
August 16	315	0.99	85	108	1.90	1.3
December 14	65	ND	88	70	1.32	0.9
Below South Fork						
March 22	1.0	ND	24	36	0.03	1.9
August 16	480	1.20	100	178	2.59	2.0
December 7	109	ND	45	82	1.45	2.0
Steese Highway Bridge						
March 29	11	ND	11	35	0.07	0.9
December 13	154	ND	195	328	0.40	2.0

ND: Not determined

Table A-20
Annual instantaneous peak discharge of Birch Creek, 1993

Station	Discharge (cfs)
Above Twelvemile Creek	ND
Below Twelvemile Creek	1,665
Above Harrison Creek	6,271
Below South Fork	9,286
At Steese Highway Bridge	ND

ND: Not determined

Table A-21
Monthly mean discharge of Birch Creek, 1993

Month	Discharge (cfs) Birch Creek Above Twelvemile Ck.	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	At Steese Highway Bridge
January	*0.7*	*10.2*	*4.7*	*8.8*	*34*
February	*0.3*	*9.0*	*1.7*	*3.2*	*21*
March	*0.1*	*8.0*	*0.6*	*1.2*	*14*
April	*31*	*78*	*258*	*436*	*592*
May	*207*	*480*	*1,881*	*3,072*	*4,482*
June	**124**	*173*	*616*	1,025	**1,900**
July	**38**	*92*	*310*	*523*	**885**
August	**36**	*106*	*361*	606	**794**
September	**86**	*192*	*690*	1,146	**1,808**
October	*59*	*135*	*809*	*842*	*1,169*
November	*18*	*46*	*222*	*257*	*406*
December	*5.8*	*20*	*61*	*78*	*141*

999 Alaska DNR data (Vohden 1994)
999 Estimated from Regression Equations

Table A-22
Daily mean discharge of Birch Creek below South Fork, 1994

Date	May	June	July	August
	Discharge (cfs)			
1		374	2,242	934
2		598	1,892	855
3		677	1,679	823
4		570	2,115	836
5		477	2,551	773
6		511	2,411	712
7		773	2,111	674
8		916	1,717	646
9		811	1,460	629
10		653	1,276	603
11		545	1,132	568
12		546	1,255	543
13		492	1,473	527
14		381	1,307	504
15		329	1,095	481
16		314	1,453	466
17		296	1,465	444
18		324	2,052	461
19		629	2,324	486
20	1,668	2,345	1,818	
21	1,185	5,794	1,598	
22	1,030	5,349	1,402	
23	965	6,088	1,256	
24	934	2,611	1,157	
25	1,097	4,529	1,090	
26	834	17,075	1,032	
27	654	7,127	972	
28	585	4,248	938	
29	426	3,353	1,026	
30	311	2,738	1,054	
31	292		968	
Maximum	1,668	17,075	2,551	934
Minimum	292	296	938	444
Mean	832	2,382	1,526	630

Recorded instantaneous peak: 10.18 feet or 19,742 cfs on June 26
Surveyed instantaneous peak: 10.25 feet or 19, 987 cfs on June 26 (from flood marks)
Recorded minimum discharge: 278 cfs on June 17
Gage operated: May 20 to September 29
Transducer line chewed by a beaver: August 19

Table A-23
Discharge measurement summary at gaged sites for Birch Creek, 1994

Date Measured	Discharge (cfs)	Stage (feet)	Width (feet)	Area (feet^2)	Avg. Velocity (ft/sec)	Avg. Depth (feet)
Above Twelvemile Creek						
February 9	0.92	ND	4.0	0.5	1.73	0.1
March 22	0.12	ND	7.0	2.1	0.06	0.4
June 26	*2,000	7.56	87	369	5.43	4.2
August 10	35	3.66	45	31	1.22	1.0
December 15	10	ND	15	10	0.92	0.8
Below Twelvemile Creek						
February 9	7.5	ND	28	19	0.48	0.6
March 22	1.9	ND	14	9	0.30	0.6
May 20	440	4.43	97	129	2.94	1.4
June 26	*2,882	7.32	139	546	5.28	3.9
July 21	224	3.77	70	75	2.65	1.2
September 4	167	3.24	66	63	2.16	1.0
September 29	73	3.01	45	33	1.96	0.8
December 14	24	ND	48	30	0.77	0.7
Above Harrison Creek						
March 23	0.1	ND	8	7	0.03	0.5
June 26	*15,340	12.03	250	2168	7.08	8.7
July 21	916	4.47	168	312	2.80	2.0
September 4	668	4.05	208	273	2.35	1.2
September 29	286	3.50	108	213	1.37	2.4
December 5	75	ND	87	78	1.32	1.0
Below South Fork						
March 24	2.3	ND	29	44	0.06	1.8
July 21	1517	2.49	320	573	2.39	1.7
September 29	443	1.39	92	150	2.91	1.8
December 5	118	ND	72	72	1.83	1.1
Steese Highway Bridge						
March 22	9.2	ND	33	23	0.46	2.2
June 26	*29,000	18.60	348	5,399	5.37	9.2
August 11	582	1.60	192	318	1.90	2.1
December 15	127	ND	160	301	0.42	2.2

* Slope-area indirect discharge survey
ND: Not determined

Table A-24
Annual instantaneous peak discharge of Birch Creek, 1994

Station	Discharge (cfs)
Above Twelvemile Creek	2,000
Below Twelvemile Creek	2,880
Above Harrison Creek	15,340
Below South Fork	19,990
At Steese Highway Bridge	29,000

Table A-25
Monthly mean discharge of Birch Creek, 1994

	Discharge (cfs) Birch Creek				
	Above Twelvemile Ck.	Below Twelvemile Ck	Above Harrison Ck	Below South Fork	At Steese Highway Bridge
January	*1.2*	*12*	*13*	*23*	*59*
February	*0.4*	*6.1*	*3.0*	*7.2*	*25*
March	*0.1*	*1.9*	*0.7*	*2.3*	*11*
April	*23*	*59*	*189*	*321*	*430*
May	*76*	*184*	*660*	*1,097*	**2,460**
June	**351**	*379*	*1,452*	2,382	**3,830**
July	**77**	*251*	*923*	1,526	**1,800**
August	**28**	*110*	*375*	630	**785**
September	**28**	*74*	*244*	*412*	**1,110**
October	*36*	*57*	*205*	*320*	*632*
November	*19*	*37*	*111*	*175*	*281*
December	*10*	*23*	*60*	*96*	*125*

999 Alaska DNR data (Vohden 1995)
999 Estimated from Regression Equations

Appendix B

Table B-1
Discharge regressions based on Birch Creek below South Fork data

	Parameters			
	m	b	r^2	Standard error
Above Twelvemile Creek	0.98	-0.63	0.88	0.43
Below Twelvemile Creek	0.93	-1.29	0.97	0.33
Above Harrison Creek	1.02	-0.63	0.98	0.29
Steese Highway Bridge	1.04	0.08	0.99	0.12

m = slope of regression line
b = y-intercept of regression line
r^2 = coefficient of determination

Table B-2
Discharge regressions based on Salcha River data (USGS)

	Parameters			
	m	b	r^2	Standard error
Above Twelvemile Creek	1.21	-5.15	0.61	0.48
Below South Fork	1.75	-6.55	0.96	0.23
Steese Highway Bridge	0.99	-0.46	0.58	0.43

m = slope of regression line
b = y-intercept of regression line
r^2 = coefficient of determination

United States Department of the Interior

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7250 (931)

To Whom It May Conceren:

Attached is a copy of the report entitled "Water Resources of Birch Creek National Wild River, Alaska: Stream Gaging Data from 1989 to 1994." This report will be followed by the instream flow analysis in the near future. If you need additional copies of this report, please contact Bunny Sterin at (907) 271-5069.

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